CLAIMS

What is claimed is:

1. A slurry useful in planarizing a surface of a wafer suited for fabrication of a semiconductor device, the slurry being comprised of:

a) sulfur-bearing compounds capable of converting copper to copper sulfide,
b) optionally, a liquid carrier,
c) optionally, an oxidizing agent,
d) optionally, inorganic polishing particles,
e) optionally, a chelating agent,
f) optionally, a buffering agent,
g) optionally, a passivating agent,
h) optionally, surfactants, emulsifying agents, viscosity modifiers, wetting agents, lubricants, soaps, and the like,
i) optionally a stopping compound to increase metal polishing selectively, and
j) optionally, a co-solvent

2. The slurry of claim 1 wherein the sulfur-bearing compound capable of converting copper to copper sulfide is a disulfide or polysulfide having the structure:

$$R_1S\text{-}S_x\text{-}S\text{-}R_2$$

wherein R_1 and R_2 are independently an organic or inorganic moiety and x is an integer from 0 to 24.

3. The slurry of claim 2 wherein R_1 and R_2 are independently an organic moiety that may include hydrocarbons or functional groups such as a hydrogen, amines, hydroxyl, carboxyl, halogen, sulfonyl, alkyl, aryl, alkaryl or combinations thereof.

4. The slurry of claim 2 wherein R_1 and R_2 are independently an inorganic functional group selected from an alkali or alkaline earth metal salts or ammonium salts or combinations thereof.

5. The slurry of claim 2 wherein the polysulfide is hydroxyethylpolysulfide.

6. The slurry of claim 1 wherein the sulfur-bearing compounds capable of converting copper to copper sulfide has a concentration from 0.00l0% to 100%.

7. The slurry of claim 1, wherein the inorganic polishing particles are selected from SiO_2, Al_2O_3, CeO_2, zirconia, calcium carbonate, cerium salts, garnet, silicates and titanium dioxide.

8. The slurry of claim 1 wherein the pH is between 2 to 13.

9. A method of modifying a surface of a wafer suited for the fabrication of a semiconductor device comprising the steps of:

a) providing a wafer comprising a first material having a surface etched to form a pattern and a second material deposited over the surface of the first material;

b) contacting the second material of the wafer with polishing pad in the presence of the working slurry containing a sulfur-bearing compound capable of converting copper to copper sulfide; and

c) relatively moving the wafer or polishing pad while the second material is in contact with a polishing pad until an exposed surface of the wafer is planar and comprises at least one area of exposed first material and one area of exposed second material.

10. The method of claim 9 wherein the slurry contains polishing particles.

11. The method of claim 9 wherein the polishing particles are fixed on the polishing pad.

12. The method of claim 9 wherein the polishing pad comprises a slurry and a polymer pad, the slurry comprising a plurality of loose abrasive particles dispersed in a slurry, the slurry contacting the metal layer of the wafer by the application of the polishing pad.

13. The method of claim 12 wherein the first material is a dielectric material and the second material is a conductive material.

14. The method of claim 12, wherein the wafer further comprises a barrier layer covering the dielectric material.

15. The method of claim 12, wherein the metal layer is a conductive metal selected from the group consisting of titanium, silver, aluminum, tungsten, tantalum, tantalum nitride, tungsten nitride, tantalum oxide, tungsten oxide, silica, copper, or alloys thereof.

16. The method of claim 12 wherein high impingement water is used to remove the abraded copper sulfide particles.

17. The method of claim 12 wherein ultrasonic radiation is used to assist in copper sulfide removal from the wafer surface.